Reference Manual: IBM 7090 Data Processing System

Selector Hold. The 10-position selectors are of the immediate pickup type. Whenever a selector pickup hub is impulsed, its contacts transfer and remain transferred until 12.5 of the punch cycle, at which time the common hubs are again connected to the normal hubs. If, however, at 12.5 the pickup hubs are still impulsed (by a sense exit, for example), the selector remains transferred until 12.5 of some succeeding punch cycle.

Sense Exits 1 and 2. Impulses are made available at these hubs through the execution of appropriately addressed PSE instructions in the main program. In general, synchronous relation between the CPU and the punch need not concern the programmer unless PSE instructions are to be used to pick up selectors or exert some control over punching operations. Points of interest regarding the execution of a PSE which addresses a sense exit hub on the punch are:

1. When addressing the punch, a PSE must be given while the channel is in operation and the punch is selected; i.e., the order must be executed after an initial WRS in the main program and before a disconnect occurs in the channel. Otherwise, the PSE has no effect and is treated as a no-operation.
2. When the punch is not in motion and the first WRS is executed, the feed is effectively locked at "D" (Figure 79). The cycle does not start until the arbitrarily positioned drive mechanism has moved to the latch point and the feed becomes unlatched (able to move). If a PSE is given immediately following the initial WRS, the impulse is available before the punch cycle has started.
3. Under the circumstances indicated in item 2, the impulse is emitted from the sense exit hub from the time the PSE is executed to 14.2, and from 12.6 through 14.2 of every cycle thereafter, until the punch is disconnected. Once the punch is disconnected, the impulse is not available until another identically addressed PSE is executed. Thus, if an IORP command is followed by an IOCD with a zero word count, the punch is disconnected at 12.6 (end-of-record) and the sense exit impulse is no longer available. If a WRS is executed immediately after the disconnect, punching continues without losing the next cycle. Notice that if it is desirable to use sense exit impulses during some cycles but not during others, some scheme such as that described in the preceding explanation is necessary to terminate the hub's impulse without terminating continuous punching.
4. A PSE instruction executed between 14.2 and 14.9 causes an exit impulse to be emitted at the end of that cycle and on all succeeding cycles from 12.6 to 14.2.
5. A PSE instruction, given any time at cycle point 9 or later, causes an impulse to be emitted from the appropriate sense exit within 6 ms. and lasting until 14.2. The impulse will be repeated in the usual manner until the punch is disconnected. On the last cycle of punch operation a PSE should not be programmed after 9 time. Once the impulse is emitted it remains active until 14.2 of the next cycle, even if the punch is disconnected. Internal damage may occur if the emitting impulse is present at the sense exit hub throughout a period when the punch is not in use.

Printer

One IBM 716 Printer (Figure 80) may be attached to any channel on the system.

The printer is equipped with 120 rotary type wheels (Figure 81). Each wheel has 48 characters including numerals, alphabetic symbols and special characters (Figure 82). Use of the stored program enables the computer to print any desired information in any form convenient to the programmer. This information is printed at the rate of 150 lines per minute. Printing format is controlled by the arrangement of the information in storage and by a control panel located on the printer.

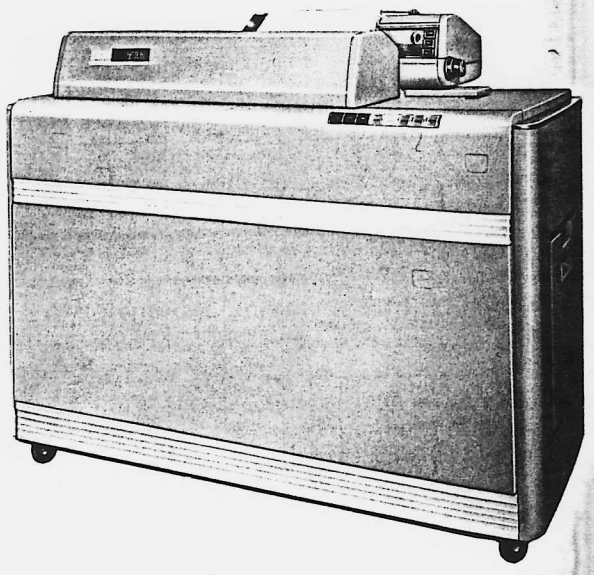

Figure 80. IBM 716 Printer

IBM Form A22-6528-3 Minor revision, August 1961

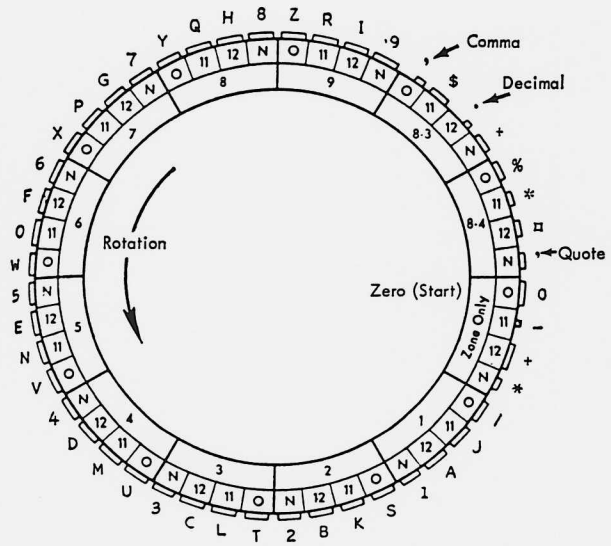

Figure 81. Type Wheel Schematic (FORTRAN)

A line is printed in a time period which is called a print cycle. During this interval the type wheel is rotated until the specified character is centered in front of the platen and then printed. The amount of rotation, and consequently the character printed, depends on the time in the print cycle when the electrical impulse initiates motion. For example, if a print wheel receives an electrical impulse during that part of the cycle designated as 9 time, the number 9 is printed. Also if the print wheel receives an impulse at 1 time and an impulse at 12 time, the print unit positions the wheel to print the letter A (according to the standard IBM code shown in Figure 83).

Printing is similar to tape and card operations with respect to the role played by the channel to which the printer is attached. A printer record corresponds to a single printed line or to the information in core storage necessary to print one line. An end-of-record condition occurs at the end of each print cycle. Consequently, all eight channel commands are available for use in a print program.

Printing a Line

To initiate printing, a WRS with a normal address specifying a channel and its attached printer may be employed. Physical motion in the printer is caused by the WRS and within 58 ms. a reset and load channel must be executed to supply the channel with its first command.

If an IOCD command with a word count of 24 is given, the channel synchronizes itself with the printer and sends 24 words from consecutive locations in core storage, each at an appropriate time, to the printer; thus one line will be printed. The characters which are printed are determined by the contents of the 24 words in core storage.

The first two words are sent to the printer at 9-time in the printer cycle. If both words contained all 1's (S, 1-35) and all other words in the card image contained 0's, the number 9 would be printed in 72 positions on the same line. The printer control panel has 72 hubs (calc exit left and right) which correspond to the 72 bit positions of the pair of words transmitted from core storage. Wherever a bit position in the first word contains a 1, an impulse is emitted by the corresponding calc exit left hub; likewise a bit in the second word creates an impulse at a calc exit right hub. The 72 hubs may be wired directly to any 72 of the 120 print entry hubs. Impulses sent to the printer via these hubs control the type wheels directly and cause specific characters to be printed. Thus, through wiring between the calc exit and the print entry hubs, each of the 72 bits from a pair of words in core storage may be made to correspond to a particular type wheel.

digit	no (N) zone	12 (Y) zone	11 (X) zone	0 zone
no digit		+	—	0
1	1	A	J	/
2	2	B	K	S
3	3	C	L	T
4	4	D	M	U
5	5	E	N	V
6	6	F	O	W
7	7	G	P	X
8	8	H	Q	Y
9	9	I	R	Z
8-3	+	.	$	,
8-4	—	¤	*	%

Figure 83. Punched Card Code

Zone / Digit	12 None	12 8-3	12 8-4	11 None	11 8-3	11 8-4	0 8-3	0 8-4	0 1	None 8-3	None 8-4
A	&	.	¤	—	$	*	,	%	/	#	@
B	/	.	¤	—	$	*	,	%	&	#	@
C	&	.	¤	—	$	*	,	%	0	#	@
D	—	.	¤	—	$	*	,	%	/	#	@
E	(This code not used)										
F	+	.	)	—	$	*	,	(	/	=	—
G	+	.	¤	—	$	*	,	%	/	+	—

Figure 82. Alternate Type Wheel Characters

The print cycle, as it progresses, goes through points designated 9-time, 8-time, ... 0-time, 11-time, 12-time. These times are analogous to those of the standard 407 that operates from card reading. At each time point, the next pair of words from a 24-word record in core storage are sent to the printer. The 24 words are designated 9-left, 9-right, and so on, corresponding to the time points at which they are sent to the printer. The record comprises a card image of exactly the type obtained by reading a card into consecutive core storage locations with each pair of words corresponding to a card row.

Note that the character printed by a given type wheel is determined by the contents of a fixed bit position in every other word of the record. Thus, if the 1-left and 12-left words have one bits and all other left words have zeros, the type wheels associated with the bit positions will print the letter A.

Printing Multiple Lines

If the word count of an IOCD command is greater than 24, additional lines may be printed. The 25th word is taken as the first word of the card image for the second line of printing; i.e., the 25th and 26th words are sent to the printer at 9-time of the second print cycle and successive words will be sent to the printer and printing will continue until the word count reaches zero. When the count reaches zero, the printer is disconnected from the channel and, if no other operation is waiting, the channel drops out of operation. If this occurs in the middle of a card image, the line is printed as though all of the missing portion of the image contained zeros.

In general any command or sequence of commands may be used in sending words to the printer. An end-of-record condition occurs following the transmission of every 24 words.

Printing with Checking

The previous statements describe printing without checking. Checking is possible because the printer can not only receive print impulses from the computer but can also send back "echo impulses" generated by the individual type-wheel position. Printing with checking requires a somewhat more complicated program, but can be accomplished without reducing the 150-line-per minute printing speed. Via control panel wiring, echo impulses may be returned to core storage in word groups which are similar to the words that were sent to the printer to be printed. The stored program can then compare the image transmitted against the image received, to insure that the type wheels were correctly positioned. During the first half of the print cycle words are sent to the printer, and during the last half of the cycle the echo words are returned from the printer. These two time periods overlap somewhat, so that echo words begin returning from the printer before all print words have been sent. The general sequence of events in a print cycle with echo checking is as follows:

1. An RDS instruction addressing a channel and its attached printer is given to initiate the first print cycle.

2. Within 58 ms. a reset and load channel must be executed, thus supplying the channel with its first command.

3. As in printing without checking, 12 pairs of words (forming the 12 rows of the card image) are taken by the channel from storage and are sent to the printer, where they determine which characters are printed. Nine pairs of echo words, similar to rows 9 through 1 of the original image, are sent from the printer back to core storage. In the standard IBM code, the digits 8-3 and 8-4 (with or without zone punching) are used for special characters. Two additional pairs of echo words provide a check that the correct print wheels have received these impulses. As a result, for all positions in the original image where both 8 and 3 rows (or 8 and 4 rows) contain 1's, the 8-3 (or 8-4) pair of echo words will contain 1's. A single type wheel causes the emission of only one echo whenever it prints a character. Zone (0-11-12) printing is not echo checked. If such characters requiring both a zone and a digit impulse are printed, only the digit impulse may be echo checked.

In printing with echo checking, an end-of-record condition occurs after 46 words have been transmitted (24 words from storage and 22 echo words returned). The exact sequence of transmission is: 9-left through 1-right written; 8-4 left and right echo words received; 0-left and right words written; 8-3 left and right echos received; 11-left and right words written; 9-left and right echos received; 12-left and right words are written; 8-left through 1-right echos received.

It is possible for the main program to compute throughout the cycle. If the channel is operated through an IOCD command with a word count of 46, it is necessary to stretch the image out over a 46-word block of storage, reserving appropriate locations for the returning echo words. By using a sequence of commands, it is possible to print an image of 24 words and also direct the echo words to any other configuration of storage locations.

Reference Manual:
709/7090 Fortran Programming System

MAJOR REVISION
(January, 1961)

This manual is a major revision of, and obsoletes: 709 FORTRAN Automatic Coding System for the IBM 709 Data Processing System, form C28-6054-1.

It includes material from:

IBM 709/7090 FORTRAN Monitor, form C28-6065, pp. 1-12

704 and 709 FORTRAN: Additional Format features, form J28-6081

704 and 709 FORTRAN: Using Function and Subroutine Names as Arguments, form J28-6082

704 and 709 FORTRAN: Boolean Expressions, form J28-6087

The initial printing of this revision included an errata sheet. Errors listed on that sheet have been corrected in this printing; no other changes have been made.

In this manual, all properties attributed to "FORTRAN" apply to the FORTRAN System for the IBM 704, 709 and 7090 Data Processing Systems; properties attributed to "709/7090 FORTRAN" apply to that system only. In the latter case, certain rules are applicable to the 32K System only. These are explicitly stated as such.

This manual presents the FORTRAN language and programming rules. Other materials covering the 709/7090 FORTRAN System are:

Programmer's Primer for FORTRAN
(Form F28-6019)

709/7090 FORTRAN Operations Manual
(Form C28-6066-2)

FORTRAN Assembly Program (FAP) for the IBM 709/7090
(Form J28-6098)

Math. Stat.
Add'l

APPENDIX B — TABLE OF SOURCE PROGRAM CHARACTERS

CHARACTER	CARD	BCD TAPE	STORAGE	CHARACTER	CARD	BCD TAPE	STORAGE	CHARACTER	CARD	BCD TAPE	STORAGE	CHARACTER	CARD	BCD TAPE	STORAGE
1	1	01	01	A	12 1	61	21	J	11 1	41	41	/	0 1	21	61
2	2	02	02	B	12 2	62	22	K	11 2	42	42	S	0 2	22	62
3	3	03	03	C	12 3	63	23	L	11 3	43	43	T	0 3	23	63
4	4	04	04	D	12 4	64	24	M	11 4	44	44	U	0 4	24	64
5	5	05	05	E	12 5	65	25	N	11 5	45	45	V	0 5	25	65
6	6	06	06	F	12 6	66	26	O	11 6	46	46	W	0 6	26	66
7	7	07	07	G	12 7	67	27	P	11 7	47	47	X	0 7	27	67
8	8	10	10	H	12 8	70	30	Q	11 8	50	50	Y	0 8	30	70
9	9	11	11	I	12 9	71	31	R	11 9	51	51	Z	0 9	31	71
blank	blank	20	60	+	12	60	20	-	11	40	40	0	0	12	00
=	8-3	13	13	.	12 8-3	73	33	$	11 8-3	53	53	,	0 8-3	33	73
-	8-4	14	14	)	12 8-4	74	34	*	11 8-4	54	54	(	0 8-4	34	74

NOTE: There are two - signs. Only the 11-punch minus sign can be used in FORTRAN source program cards. Either minus sign may be used in input data to the object program; object program output uses the 11-punch minus sign.

The character $ can be used in FORTRAN only as Hollerith text in a FORMAT statement.